

Article

Enterprise Risk Management, Financial Reporting and Firm Operations

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Abstract: We examine financial reporting and firm operations, focusing specifically on the roles of ‘enterprise risk management’ (ERM), within which a holistic approach is taken to the conceptualization and management of all types of risk. We measure ERM implementation based on information obtained from 2004–2014 financial reports on 648 firms. We find that ERM implementation is associated with higher reporting quality and reduced volatility in future firm performance in terms of both operating cash flows and stock returns. Our difference-in-differences analyses indicate that these associations were strengthened by the introduction of the Securities and Exchange Commission (SEC) final rule in 2010, requiring increased and improved disclosure related to risk oversight. Our findings, which we attribute to the incremental effects of ERM and enhanced risk disclosure over time, point to the substantial advantages of ERM and the importance of related disclosure, which should prove to be of interest to firms as well as policymakers.

Keywords: enterprise risk management; ERM; financial reporting quality; firm operations



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1. Introduction

The concept and frameworks of ‘enterprise risk management’ (ERM) were originally formulated between 1998 and 2009, a period marked by a series of high-profile business scandals and failures, not least of which were the collapses of Enron and WorldCom.¹ Whilst the silo approach in traditional risk management disregards the interrelations between various types of risk, ERM addresses the organizational benefits when risks are examined jointly (Nocco and Stulz 2006). The main emphases in ERM are comprehensive risk management, stronger internal control, and higher transparency and accountability, all of which ultimately lead to more informed strategic decision-making (Chapman 2006; Moeller 2011; Resende et al. 2024), higher firm value (Hoyt and Liebenberg 2011; Chen et al. 2020; Malik et al. 2020), and better market reaction (Beasley et al. 2008; Baxter et al. 2013).

ERM programs emphasize the achievement of strategic objectives whilst jointly managing risk, aligning such risk with strategy and performance to penetrate and improve all aspects of the firm. Our aim in this study is to identify the benefits of ERM through the financial reporting and operational aspects of firms based on three research questions. Firstly, we investigate whether an ERM program can contribute to better financial reporting quality. Secondly, we test whether ERM is associated with improved future operational performance; this association, if found, will reveal the benefits of ERM in terms of preparing firms for future operational uncertainty through the alignment of operational risks and

strategies. Thirdly, given that the implementation and disclosure of ERM are not mandatory, the associations addressed in this study may be driven by exogenous events, such as regulatory requirements or macro-economic circumstances. We therefore investigate whether ERM can have incremental effects on reporting quality and future firm performance in consideration of the issuance by the US Securities and Exchange Commission (SEC) of its final rule (33-9089) in 2010, which regulated the requirement for increased, and more improved, disclosure relating to risk oversight information in the proxy statement disclosures of public companies.

We construct a sample of 648 firms across different industries providing us with 5998 firm-year observations between 2004 and 2014. Text-search techniques are used to manually collect ERM information from the related financial reports, including SEC 10-K/10-Q filings and proxy statements, based on keyword identifiers which included ‘holistic approach’, ‘Chief Risk Officer’ (CRO), and ‘risk committee’. The results obtained from our sample of firms—which has an average ERM adoption rate of 31.41 percent—show that firms with larger size, a more established history, longer operating cycles, and better performance (measured by their return on assets and market-to-book ratio) are more likely to engage in some form of ERM program implementation. Our findings reveal that ERM implementation is generally associated with higher financial reporting quality (such as lower discretionary accruals) and reduced earnings manipulation behavior (such as the avoidance of reporting losses and meeting or beating analyst earnings forecasts). We also find that ERM is related to lower volatility in both future operating cash flows and future stock returns.

Overall, ERM applied from strategy through operations facilitates the effective management of financial reporting risk and aligns operational risk to mitigate potential volatility in a firm’s future performance. We also consider exogenous events that may influence the effects of ERM over time. Following the introduction of the SEC final rule (33-9089) in 2010, ERM has generally become associated with higher reporting quality and lower volatility in future performance, results which we attribute to the increase in ERM implementation and the enhanced disclosure of ERM-related activities.

The latest ERM survey shows that more firms and organizations have started using ERM programs over recent years.² Our empirical findings on the benefits of ERM programs provide policy insights for both regulators and practitioners to consider the implementation, value, and disclosure of ERM activities.

The remainder of this paper is organized as follows. In Section 2, we discuss the background and literature on ERM to develop the main hypotheses. Our main research design is presented in Section 3, followed in Section 4 by the details of sample construction and descriptive statistics. Section 5 presents our main empirical results with further discussion. Finally, the conclusions are presented in Section 6.

2. Hypothesis Development

ERM is a holistic program to be taken into consideration in strategic decision-making processes as a way of aligning and managing risks from a wide variety of sources (Baxter et al. 2013). While there is currently no universal definition or consistent implementation, ERM offers a comprehensive and systematic approach to lowering the overall risk of failure and increasing the operational performance and value of a firm (Gordon et al. 2009). The heightened financial volatility also underscores the importance of ERM. Expertise in key roles, such as the Chief Risk Officer (CRO), is critical, with studies linking CRO expertise to higher ERM quality and firm performance, especially during financial instability (Bailey 2022). Effective ERM enhances a firm’s value by mitigating risks, with

factors like firm size, auditor quality, and governance structures influencing ERM outcomes (Hidayah et al. 2024).

Since a complete ERM program is applied on an enterprise-wide basis, it penetrates each functional area, leading to improved strategic decision-making (Chapman 2006; Moeller 2011), alignment and integration of risk management (Rosenburg and Schuermann 2006), a reduction in the probability of significant cash flow deficits (Nocco and Stulz 2006), lower stock return volatility (Eckles et al. 2014; Ittner and Keusch 2017), lower earnings volatility (Edmonds et al. 2015), and better risk governance (Lundqvist 2015).

Although ERM implementation shares common aspects of the COSO (2013)³ ‘internal control’ (IC) framework, including operations, reporting, and compliance, the strategic focus is quite different (Chesley et al. 2016; COSO 2017).⁴ The implementation of an ERM program not only strengthens the same objectives as those set by IC, but it also aligns risk with strategy-setting; thus, when setting up their strategies, an organization should be capable of understanding (i) the ways in which mission, vision, and core values form various types and amounts of risk; (ii) the potential risk of non-alignment of strategies and objectives with mission, vision, and core values; (iii) the potential for the organization to expose itself to risks associated with the chosen strategy; and (iv) the types and amounts of risk involved in executing the strategies and achieving the objectives (COSO 2017, p. 40).

Given that an entity’s mission, vision, and core values define what it strives to be, as well as the ways in which it conducts its business and reports to stakeholders, we would expect to find that the integration between ERM and strategy should reaffirm these elements, driving the entity’s overall performance and ultimately leading to further improvements in other areas, such as reporting or operational aspects.

2.1. ERM and Financial Reporting

Most related studies have tended to focus on the determinants of ERM and the subsequent effects on firm value, with various studies noting that ERM is more likely to be adopted by firms of larger size (Beasley et al. 2008; Gordon et al. 2009), with higher leverage (Liebenberg and Hoyt 2003), higher earnings volatility, and higher CEO pay-performance sensitivity (Pagach and Warr 2011). However, the association between ERM implementation and firm value remains inconclusive within the extant literature. On the one hand, ERM has been shown to have no impact on firm value in terms of earnings volatility (Pagach and Warr 2015) or managerial responsibility (Beasley et al. 2011); on the other hand, however, ERM is credited with increases in both market response (Beasley et al. 2008) and firm value.⁵

To better understand the effects of ERM implementation on firm value, prior literature has started to investigate the association between ERM and reporting quality. A survey carried out by Cohen et al. (2017) demonstrated that ERM adoption could help to improve the financial reporting process, which encompasses management reporting, IC, and auditing. Effective ERM adoption is expected to enhance managers’ ability to identify, assess, and manage both internal and external business risks that will affect the financial reporting process, such as making appropriate accounting estimates and disclosures. The findings of Johnston and Soileau (2020), for example, suggest that ERM implementation helps to reduce the estimation error of accounting accruals. Considering that effective ERM helps to reduce the possibility of fraudulent or opportunistic reporting, external auditors may rely more on internal audit work, which, in turn, changes their assessment of client risks, audit plans, or charges on auditing financial reports (Gao et al. 2018; Hidayah et al. 2024). Using data on Taiwan, Lin et al. (2013) also found that firms with ERM programs in place preferred real economic activities over accruals from earnings management.

The latest COSO ERM framework (COSO 2017) discusses the roles of ERM in terms of the associations between respective objectives, including the relationship between strategy and reporting. ERM taxonomy, which reports a comprehensive set of risk categories for each functional area within an entity, also provides important information designed to identify risks and to drive the entity's strategy and business objectives (COSO 2017, pp. 345–46). Thus, ERM has specific effects on strategy, reporting, and other aspects of an organization. Furthermore, the strategy adopted by an entity increases the demand for data, which, in turn, influences its reporting environment (COSO 2017, p. 334). The need for improvements in information quality caused by such higher demand for data could be addressed through an ERM program, given its holistic risk considerations across all business functions within the organization. As a result, we might expect to find the specific focus on strategy within an ERM program further influencing the reporting objectives of the related firms.

While ERM is discussed in previous research as a holistic approach to risk management and its benefits for strategic decision-making, operational performance, and firm value are highlighted, there is limited emphasis on its direct impact on financial reporting quality. We expect that ERM helps managers evaluate an organization-wide array of risks in integration and strategize how they should respond to potential risks that might affect their reporting estimates, such as future cash flows. The role of ERM in aiding the development of reporting estimates is expected to contribute to the quality of financial reporting. We attempt to address this gap by proposing H1, which explicitly examines the relationship between ERM implementation and financial reporting quality.

H1. *The implementation of an ERM program has a positive association with the financial reporting quality of a firm.*

2.2. ERM and Firm Operations

In addition to reporting quality, ERM addresses operational objectives, a factor which is also covered by the IC framework; however, the objectives of IC relate more specifically to the effectiveness and efficiency of an entity's operations, whereas those of ERM are integrated into the entity's strategic plan through the process of setting up strategies and business objectives (COSO 2017).

ERM takes a holistic view in the pursuit of operational objectives, which can be discussed as follows. Firstly, an ERM program takes a portfolio view in order to enhance an organization's ability to identify potential events and establish responses as a means of reducing operational surprises and associated losses or costs (COSO 2004). Secondly, ERM can align the appetite for risk, or risk tolerance, with a strategy aimed at influencing the execution of an organization's operating model and performance (COSO 2017, pp. 56–58). Thirdly, an ERM framework often calls for stronger risk governance and culture, such as a critical mass of independent directors as a minimum (normally at least two independent directors) or, at the very least, a majority of independent external directors (COSO 2004).

The value of an organization is created, preserved, or eroded by management decisions in all activities, from strategy to daily operations, with such value being maximized when management sets its strategy and objectives in ways that achieve an optimal balance between organizational goals (such as growth or returns) and the related risks (COSO 2004). Nevertheless, despite operational objectives being covered by both ERM and IC, in their examination of the effects of business operations on firm value, most prior related studies have tended to restrict their focus to just IC. For example, Feng et al. (2015) found that ineffective IC was associated with lower inventory turnover and a higher probability of reporting inventory impairment, essentially highlighting the importance of IC in day-to-

day operations. Thus, the effects of ERM, incorporating strategic considerations affecting an entity's operations, do not yet seem to have been fully examined.

While IC focuses on ensuring the reliability of financial reporting, compliance, and operational efficiency, ERM elevates operational objectives to a higher, strategic level. By integrating strategy-setting with the management of operational activities, ERM creates synergy with IC. This synergy arises as ERM identifies, prioritizes, and aligns risks with both strategic and operational objectives, enabling management to reduce operating costs and identify opportunities for business growth (COSO 2017, pp. 33–35). The combined strength of IC and ERM enhances an entity's ability to identify, assess, quantify, and respond to risks in a timely manner. As managers gain a deeper understanding of the entity's risk profile through ERM, they can adjust operating models to reduce future performance volatility. This interplay between IC and ERM leads us to our second hypothesis.

H2. *The implementation of an ERM program is negatively associated with volatility in the future operations of a firm.*

2.3. Disclosure of Risk Oversight Information

Since ERM adoption is still not mandatory (Moeller 2011), when examining the effects of ERM, it is very important to consider the impact of regulatory changes on risk information disclosure levels. The SEC final rule (33-9089), which came into effect on 28 February 2010, is an amendment requiring enhancements to the level of risk disclosure already imposed on firms, including policies and practices relating to risk management and the role of the board in risk oversight. The SEC has indicated that this amendment, which significantly improves risk information availability, will not only encourage firms to increase transparency with regard to their corporate governance practices but also provide them with the flexibility to describe their risk oversight mechanism and their risk management process from business strategy through to daily operations (SEC 2009).

Previous studies have established a connection between risk management activities and changes in earnings volatility, demonstrating that higher-quality risk management practices tend to reduce earnings volatility, particularly following the introduction of the SEC final rule (Edmonds et al. 2015). However, the literature remains limited in exploring how regulatory changes, such as the SEC final rule (33-9089), shape the adoption and disclosure practices of enterprise risk management (ERM). To address this gap, we build on prior research by proposing H3a and H3b, which investigate the influence of the SEC final rule on ERM's relationship with financial reporting quality and operational volatility. This approach allows us to extend the understanding of how regulatory shifts impact ERM practices and their broader financial implications.

In the pre-SEC final rule period, our results on firms that had implemented ERM but not adequately disclosed it until the SEC final rule tend to bias our analysis toward the null. Therefore, any positive effects of this regulatory change, if found, could be attributable to either an increase in ERM implementation or enhanced disclosure of ERM-related activities, or both. This examination should provide regulators and practitioners with a better understanding of the regulatory effects of the risk disclosure policy when designing or implementing an ERM program. Our third hypothesis is, therefore, stated as follows.

H3a. *The implementation of an ERM program is more positively associated with financial reporting quality in the post-risk disclosure requirement period.*

H3b. *The implementation of an ERM program is more negatively associated with volatility in future operations in the post-risk disclosure requirement period.*

3. Research Methodology

3.1. Measurement of ERM

Given that there is neither a universal definition nor a regulatory requirement for ERM, it is clearly very difficult to determine the adoption, level of completion, or effectiveness of ERM for a firm. ERM has been identified and/or measured in several prior studies based upon either survey data (Altuntas et al. 2011; Grace et al. 2015) or S&P ERM ratings (McShane et al. 2011; Baxter et al. 2013); however, the surveys/ratings used in these studies are all limited to small sample size and specific industries.

Various other studies have used keyword/text search techniques as the means of identifying ERM adoption disclosure, with some employing indirect proxies to measure the completeness or effectiveness of ERM implementation. Hoyt and Liebenberg (2011), for example, carried out a detailed text search of financial reports, newswires, and other media sources in an attempt to identify evidence for the creation of an indicator of ERM activity, although the completeness of ERM was not specifically measured. Their search strings included ERM-related phrases, such as ‘enterprise risk management’, ‘chief risk officer’, ‘risk committee’, and ‘strategic, consolidated, holistic or integrated risk management’.⁶

Gordon et al. (2009) had earlier measured ERM based on a two-step approach. Firstly, they used keywords similar to those discussed above to identify firms disclosing ERM implementation in their 10-K and 10-Q reports. Secondly, they employed a series of indirect, observable measures as proxies for ERM objectives relating to strategy, operations, reporting, and compliance, thereby constructing an index of ERM effectiveness. This method has been adopted in subsequent studies on risk management activities, such as Lin et al. (2013) and Edmonds et al. (2015). However, the first stage, identifying ERM disclosure, is not always performed.⁷

We measure ERM adoption using the approach proposed by Liebenberg and Hoyt (2003), which relies on disclosures in financial reports such as SEC 10-K and/or 10-Q filings and proxy statements. Specifically, we assess whether a firm meets any of the following three conditions: (i) the firm uses synonymous terms to disclose its adoption of an ERM program or its implementation of holistic, integrated, or consolidated approaches, techniques, and strategies for risk management; (ii) the firm establishes a dedicated role for risk management within its senior management team, such as a Chief Risk Officer (CRO), Chief Compliance and Risk Officer, or a similar position; and (iii) the firm’s board of directors includes an independent risk committee responsible for overseeing its risk management policies and framework.

These conditions, as identified by Liebenberg and Hoyt (2003), are widely recognized as indicators of ERM implementation. Condition (i) captures firms that explicitly disclose their use of ERM-related terminology, while conditions (ii) and (iii) reflect organizational structures that support ERM adoption. Following Hoyt and Liebenberg (2011), we create a binary indicator variable, ERM_{it} , which takes the value of 1 if a firm meets any of the three conditions above and 0 otherwise. This approach allows us to identify firms that have implemented ERM to some degree. Since ERM_{it} does not account for the extent or completeness of ERM adoption, we further construct an ERM completeness score ($ERMS_{it}$). This score ranges from 0 to 3, with each point assigned for meeting one of the three conditions. A higher score indicates a more comprehensive implementation of ERM within the firm. By using both ERM_{it} and $ERMS_{it}$, we are able to distinguish between firms that have adopted ERM at varying levels of completeness, providing a more nuanced understanding of ERM implementation across our sample.

3.2. Main Research Models

The aim in our first main model is to explore the association between ERM and financial reporting quality, noting that financial reporting quality has often been measured in terms of discretionary accruals in prior related studies (Jones 1991). As a proxy, this measure has been linked to working capital (Dechow et al. 1995), cash flows (Dechow and Dichev 2002; Hribar and Collins 2002), performance (Kothari et al. 2005), and earnings management incentives.⁸ Such accruals were categorized by Allen et al. (2013) in an attempt to document their relationships with earnings quality and firm characteristics.

Firm-level characteristics have also been widely used as controls in several related studies, with these controls including the length of the operating cycle, incidences of losses, standard deviations in sales, cash flows, firm size, book-to-market ratio, industry affiliation, and accounting choices.⁹ Other financial reporting quality measures include examinations of specific events, such as meeting or beating analyst forecasts (Lim and Tan 2008), restatements (Dechow et al. 2010), loss avoidance (Matsumoto 2002), and small earnings surprises (Frankel et al. 2002).

We draw on prior related studies to construct financial reporting quality measures and examine the relationship between ERM adoption, completeness, and financial reporting quality based on the following regression model:

$$AQ_{it} = \alpha_0 + \alpha_1 ERM_{it} \text{ or } ERMS_{it} + \alpha_2 SIZE_{it} + \alpha_3 ROA_{it} + \alpha_4 MTB_{it} + \alpha_5 LOSS_{it} + \alpha_6 VOL_S_{it} + \alpha_7 VOL_C_{it} + \alpha_8 \Delta SALES_{it} + \alpha_9 CYCLE_{it} + \alpha_{10} LEV_{it} + \alpha_{11} ICW_{it} + \alpha_{12} CG_{it} + \alpha_{13} AGE_{it} + \alpha_{14} BIG4_{it} + \alpha_{15} HHI_{it} + \varepsilon_{it} \quad (1)$$

where AQ_{it} measures financial reporting quality, which includes the magnitude of discretionary accruals ($ADACC_{it}$), small positive income ($SMALL_{it}$), and meeting or beating analyst earnings forecasts (MBE_{it}). ERM_{it} is the indicator of ERM adoption, and $ERMS_{it}$ is a score measuring the completeness of an ERM program. The detailed definitions of the main variables and all other variables are provided in Table 1, where the subscript i (t) denotes the firm (fiscal year).

Table 1. Definitions of the variables in the main research models.

Variables	Definitions
ERM_{it}	Indicator variable taking the value of 1 if ERM is adopted in the firm-year; otherwise, 0.
$ERMS_{it}$	The relative degree of ERM usage in a firm-year (score 0–3) based on three conditions: (i) employing a holistic process and framework for risk management; (ii) appointing a Chief Risk Officer (CRO) in the senior management team; and (iii) the inclusion of an independent risk committee on the board of directors to oversee a firm’s risk management policies. Each condition is assigned 1 point.
$ADACC_{it}$	Absolute value of performance-adjusted abnormal accruals estimated based on Kothari et al. (2005).
$SMALL_{it}$	Indicator variable for small positive income taking the value of 1 if net income deflated by start of year total assets is between 0.0 and 0.01; otherwise, 0.
MBE_{it}	Indicator variable for meeting or beating analyst forecasts which is equal to 0 (1) if actual EPS is lower (not lower) than the final analyst forecast median from I/B/E/S prior to the earnings announcement.
SD_OCF_{it}	Standard deviation of net operating cash flows in the following three years scaled by average total assets.
SD_RET_{it}	Standard deviation of stock returns in the following three years deflated by average total assets.
ICW_{it}	Indicator variable taking the value of 1 if there is an internal control weakness in the firm-year; otherwise, 0.
$SIZE_{it}$	Natural logarithm of market capitalization at the start of the year.
ROA_{it}	Return on total assets: net income divided by total assets at the start of the year.
MTB_{it}	Market-to-book ratio.
$LOSS_{it}$	Indicator variable taking the value of 1 if the firm had a net loss in the previous year; otherwise, 0.
VOL_E_{it}	Standard deviation of earnings before extraordinary items in the previous three years, deflated by average total assets.

Table 1. Cont.

Variables	Definitions
VOL_S_{it}	Standard deviation of sales in the previous three years, deflated by average total assets.
VOL_C_{it}	Standard deviation of net operating cash flows in the previous three years, scaled by average total assets.
$\Delta SALES_{it}$	Percentage change in sales from the previous year.
$CYCLE_{it}$	Natural logarithm of the average of $[(Net\ Sales/360)/Average\ Accounts\ Receivable] + [(Cost\ of\ Goods\ Sold/360)/Average\ Inventory]$, calculated from 2004 to 2014.
LEV_{it}	Leverage: calculated as total debts, deflated by total assets at the start of the year.
CG_{it}	Corporate governance score (percentile) from Thomas Reuters' ASSET4 database.
AGE_{it}	Natural logarithm of the number of years, as of 2014, that CRSP data are available on the firm.
$BIG4_{it}$	Indicator variable taking the value of 1 for the big four accounting firms; otherwise, 0.
HHI_{it}	Herfindahl index: the sum of squared market shares (percentage of total industry sales for all firms available in Compustat North America based on the firm's two-digit SIC code).
$POST_{it}$	Indicator variable taking the value of 1 if the firm-year is in the period after 28 February 2010 (the effective date of the SEC final rule 33-9089); otherwise, 0.
$ERMI_{it}$	Proxy for the strategic effects of enterprise risk management, which is the residual term of regressing $ERMS_{it}$ on the proxies of internal control objectives in operations, reporting, and compliance if $ERMS_{it}$ is not equal to 0; otherwise, 0.

The discretionary accruals are measured based on the following steps. Firstly, consistent with the prior accounting literature (Dechow et al. 1995; Bhattacharya et al. 2003), we compute accruals (ACC_{it}) as:

$$ACC_{it} = (\Delta Current\ Assets_{it} - \Delta Cash_{it} - \Delta Current\ Liabilities_{it} + \Delta Short-term\ Debt\ in\ Current\ Liabilities_{it} + \Delta Taxes\ Payable_{it} - Depreciation_{it}) / Total\ Assets_{it-1} \quad (2)$$

where Δ represents the change in value in a given year.

Secondly, we follow several other prior related studies to modify the Jones (1991) model and estimate performance-adjusted discretionary accruals using two-digit SIC codes and years, with at least 30 observations being required in each industry-year.¹⁰

$$ACC_{it} = \beta_0 + \beta_1(1/TotalAssets_{it-1}) + \beta_2(\Delta REV_{it} - \Delta REC_{it}) + \beta_3PPE_{it} + \beta_4ROA_{it} + \gamma_{it} \quad (3)$$

where PPE_{it} refers to property, plant, and equipment; ΔREV_{it} represents the change in net sales; and ΔREC_{it} represents the change in net receivables. All three of these measures are scaled by initial total assets ($TotalAssets_{it-1}$). ROA_{it} refers to the return on assets, which is calculated as total net income divided by total assets at the start of the year. The firm-year residuals estimated from the above equation are defined in this study as performance-adjusted discretionary accruals using the absolute value $ADACC_{it}$.

In addition to accruals quality, we also employ two indicators of earnings benchmarking, $SMALL_{it}$ and MBE_{it} , as alternative dependent variables and proxies of financial reporting quality. $SMALL_{it}$ is an indicator of small positive income used to capture potential manipulation of the firm's books to avoid losses, thereby reflecting lower financial reporting quality.¹¹ MBE_{it} identifies firm-years meeting or beating analyst earnings forecasts based upon Frankel et al. (2002); this indicator suggests that earnings management is more likely to occur in firms just meeting or beating the benchmark than in those firms just missing the benchmark. We then revise Equation (1) to include the regression and model combinations to examine their relationships with ERM.

Several prior studies have also confirmed the incentives of managers to continuously meet or beat analyst 'earnings per share' (EPS) forecasts since such forecasts are a further

benchmark of the market expectations of a firm's performance. Examples of these incentives include higher assignment of firm valuations (Kasznik and McNichols 2002), higher equity return premiums (Bartov et al. 2002; Brown and Caylor 2005), better bond ratings (Jiang 2008), and lower costs of capital (Duarte et al. 2008; Brown et al. 2009).

Our next main model examines the roles of ERM in future firm operations and performance. Several different measures of firm operations and performance are suggested in prior studies examining risk management activities, such as Tobin's Q (Hoyt and Liebenberg 2011), return on assets (Lin et al. 2013), cumulative abnormal returns (Baxter et al. 2013), and earnings volatility (Edmonds et al. 2015). In order to examine the long-term operational benefits of ERM and test our second hypothesis, we follow Edmonds et al. (2015) to address whether ERM implementation is associated with volatility-based measures of firm operations; we construct the following regression model:

$$FOP_{it} = \beta_0 + \beta_1 ERM_{it} \text{ or } ERMS_{it} + \beta_2 SIZE_{it} + \beta_3 ROA_{it} + \beta_4 MTB_{it} + \beta_5 LOSS_{it} + \beta_6 VOL_E_{it} + \beta_7 VOL_C_{it} + \beta_8 \Delta SALES_{it} + \beta_9 CYCLE_{it} + \beta_{10} LEV_{it} + \beta_{11} ICW_{it} + \beta_{12} CG_{it} + \beta_{13} AGE_{it} + \beta_{14} BIG4_{it} + \epsilon_{it} \quad (4)$$

where FOP_{it} is the measure of volatility in future operational performance, including volatility in future net operating cash flows (SD_OCF_{it}) and stock returns (SD_RET_{it}). As an additional control for the volatility in previous earnings, (VOL_E_{it}) is also included in this test. The detailed definitions of these variables are provided in Table 1.

In addition, we employ a difference-in-differences (DID) analysis to explore the effects of ERM on financial reporting quality and future firm performance following the introduction of the SEC final rule (33-9089) in 2010, which regulated the requirement for increased and improved disclosure in risk oversight. Equations (1) and (4) are both revised to fit the DID research design, with an additional indicator, $POST_{it}$, being created for the post-SEC final rule period. The interaction term, $POST_{it} \times ERM_{it}$, is then included in the revised equations to test whether the interactions have any significant association with the measures of financial reporting quality and future operational performance.

Since the implementation of ERM is not mandatory, the SEC final rule may have not only increased the availability of risk information for firms and investors but also encouraged firms to implement ERM programs aimed at aligning their risks and strategic objectives. We, therefore, expect to find the incremental effects of ERM and the coefficients on $POST_{it} \times ERM_{it}$ being negative across all models.

4. Sample and Data

4.1. Sample

Shared common objectives relating to reporting, operations, and compliance between ERM and IC programs imply interconnecting relationships between the two frameworks (Chesley et al. 2016; COSO 2017); our analysis in the present study, therefore, begins in 2004—the year in which the SOX Act (Section 404) required IC assessment to be carried out by an external auditor—with our sample period continuing through to 2014. Given that all non-accelerated filers were exempt from the auditor attestation requirement introduced by the Dodd–Frank Act in 2010, these firms are excluded from our analysis in the subsequent sample selection process.

Considering that the establishment of ERM is extremely time-consuming and that its effects, from various perspectives, should be examined over a longer period of time, we initially required that financial information and stock price data must be available on all observations for each sample year. While it reduced the total number of observations (firms) in Compustat North America from 136,564 (18,822) to 48,532 (4412), it nevertheless helped us to focus on the long-term effects of ERM. One potential concern here is that young or growth firms, such as high-tech firms, may be excluded, thereby introducing bias

into our results; however, since these firms may also have insufficient time or tolerance to complete an ERM program, their inclusion in the sample could lead to biased results. We, therefore, attempt to deal with this concern through further analyses.¹²

We start by obtaining all of the necessary financial information on firms with complete data for each sample year from Compustat North America and then merge this information with the CRSP database on stock prices. We subsequently combine the dataset with Audit Analytics databases to retrieve the IC information. After deleting missing data in all of the explanatory variables and excluding financial firms,¹³ we constructed a dataset comprising 648 firms and 5998 firm-year observations. Full details of the sample selection procedure are provided in Table 2.

Table 2. Sample selection.

Firms	Total
Firm observations between 2004 and 2014 in Compustat North America	18,822
Less: Firms with missing values between 2004 and 2014	−14,410
Firms with consecutive observations from 2004 to 2014	4412
Less: Firms with missing values between 2004 and 2014 in CRSP	−2840
Sub-total	1572
Less: Non-accelerated filers in Audit Analytics between 2004 and 2014	−363
Sub-total firm observations available between 2004 and 2014	1209
Less: Missing firm data in SEC filing and tested variables	−528
Financial firms	−33
Final sample firm observations	648
Firm-Year Observations	Total
Firm-year observations between 2004 and 2014 in Compustat North America	136,564
Less: Missing firm-year observations between 2004 and 2014	−88,032
Consecutive firm-year observations between 2004 and 2014	48,532
Less: Missing firm-year observations in CRSP between 2004 and 2014	−33,299
Sub-total	15,233
Less: Non-accelerated filers in Audit Analytics between 2004 and 2014	−3796
Sub-total firm observations available between 2004 and 2014	11,437
Less: Missing firm data in SEC filing and tested variables	−5131
Financial firms	−308
Final sample firm observations	5998

We searched financial reports, including SEC 10-K/10-Q filings and proxy statements, to identify ERM implementation based on the three conditions of whether (i) a firm discloses its adoption of an ERM program or the use of holistic approaches to risk management, (ii) a firm specifically sets up a CRO or similar risk management role within the senior management team, and (iii) the board of directors includes an independent risk committee to oversee the firm's risk policies.

According to our analyses, firms will often disclose risk strategies, risk management policies, or related information in Item 1A of their 10-K filings, which relates to risk factors or business risks. Some firms will also disclose risk information in Item 4, whilst information on the appointment of a CRO or a risk committee, if any, is generally available from the disclosures relating to executive officers or committee members. In their proxy statements, risk information is often presented in 'committee duties' or the role of the board in the 'risk oversight' section, a requirement that came into effect after 2010. Examples of the disclosure of ERM implementation are listed in Appendix A.¹⁴

We also follow Hoyt and Liebenberg (2011) to create an indicator, ERM_{it} , which is designed to identify those firms within which any of the above conditions have been met and ERM has been implemented. We then analyzed the adoption rate of ERM across the

whole sample. The details of the sample composition by industry and year are presented in Table 3, which shows that, as compared to the findings in the prior studies, in our sample, there were more firm-year observations in which ERM had been implemented (31.41 percent);¹⁵ possible reasons for this are provided below.

Table 3. Sample composition.

Variables	No. of Obs.	No. of Firms	SIC	$ERM_{it} = 1$	$ERM_{it} = 0$	Adoption Rate (%)
Panel A: Industry composition						
Chemical and Allied Products	548	50	28	126	422	22.99
Electronic Equipment	504	46	36	195	309	38.69
Machinery	490	45	35	149	341	30.41
Electric, Gas, and Sanitary	463	44	49	145	318	31.32
Instruments	418	35	38	131	287	31.34
Oil and Gas Extraction	377	37	13	107	270	28.38
Business Services	293	34	73	103	190	35.15
Transportation Equipment	247	23	37	82	165	33.20
Food	216	20	20	56	160	25.93
Others	2442	314	—	790	1652	32.35
Totals	5998	648	—	1884	4114	31.41
Panel B: Year composition						
2004	535	—	—	124	411	23.18
2005	543	—	—	135	408	24.86
2006	542	—	—	138	404	25.46
2007	543	—	—	141	402	25.97
2008	544	—	—	149	395	27.39
2009	545	—	—	165	380	30.28
2010	547	—	—	189	358	34.55
2011	548	—	—	191	357	34.85
2012	545	—	—	206	339	37.80
2013	546	—	—	213	333	39.01
2014	560	—	—	233	327	41.61
Totals	5998	—	—	1884	4114	31.41

Firstly, in order to improve the transparency of the role of the board in risk oversight, the SEC final rule (33-9089), which came into effect in February 2010, required the enhancement of disclosure relating to risk-related management control systems. Secondly, in the aftermath of the global financial crisis in 2007–2008, firms may have begun placing greater emphasis on risk management, leading to the implementation of their own ERM program. In 2014, the last sample year, the ERM adoption rate was 41.61 percent, a finding that is comparable to the 2016 survey results of [Beasley et al. \(2017\)](#), which showed that 49% of public companies claimed to have a complete ERM program in place.

4.2. Descriptive Statistics

The descriptive statistics and breakdown by ERM adoption are reported in Table 4, from which we can see that firms using ERM are generally found to have weaker performance-adjusted discretionary accruals ($ADACC_{it}$) and a lower probability of reporting small positive income ($SMALL_{it}$) or meeting or beating earnings forecasts (MBE_{it}), thereby implying that these firms have better financial reporting quality than firms with no ERM adoption. Furthermore, volatility in future firm performance (SD_OCF_{it} and SD_RET_{it}) is found to be lower for firms implementing ERM. Firms with ERM are also generally found to be larger in size ($SIZE_{it}$), have a longer operating cycle ($CYCLE_{it}$), longer history (AGE_{it}), and lower variations in prior performance (VOL_E_{it} , VOL_S_{it} , and VOL_C_{it}).

Table 4. Descriptive Statistics.

Variables	Pooled Sample			$ERM_{it} = 1$			$ERM_{it} = 0$			Differences
	No. of Obs.	Mean	S.D.	No. of Obs.	Mean	S.D.	No. of Obs.	Mean	S.D.	
$ADACC_{it}$	5998	0.046	0.066	1884	0.044	0.064	4114	0.047	0.064	−0.003 *
$SMALL_{it}$	5998	0.112	0.315	1884	0.110	0.317	4114	0.113	0.317	−0.003
MBE_{it}	5998	0.302	0.459	1884	0.287	0.462	4114	0.309	0.462	−0.022 **
SD_OCF_{it}	4557	0.051	0.062	1663	0.046	0.049	2894	0.054	0.049	−0.008 ***
SD_RET_{it}	4557	0.023	0.112	1663	0.010	0.025	2894	0.030	0.025	−0.020 ***
ERM_{it}	5998	0.314	0.364	1884	1.000	0.000	4114	0.000	0.000	1.000 ***
$ERMS_{it}$	5998	0.407	0.341	1884	1.295	0.674	4114	0.000	0.000	1.295 ***
$SIZE_{it}$	5998	8.631	1.364	1884	8.965	1.313	4114	8.478	1.175	0.487 ***
ROA_{it}	5998	0.152	0.092	1884	0.161	0.086	4114	0.148	0.104	0.013 ***
MTB_{it}	5998	1.609	6.553	1884	1.977	8.511	4114	1.440	4.845	0.537 **
$LOSS_{it}$	5998	0.112	0.315	1884	0.113	0.317	4114	0.112	0.310	0.001
VOL_E_{it}	5998	0.355	0.619	1884	0.344	0.573	4114	0.360	0.709	−0.016
VOL_S_{it}	5998	0.686	1.803	1884	0.612	1.356	4114	1.720	1.658	−0.108 ***
VOL_C_{it}	5998	0.794	0.306	1884	0.697	0.839	4114	0.838	1.314	−0.141 ***
$\Delta SALES_{it}$	5998	−0.006	0.024	1884	−0.004	0.023	4114	−0.007	0.024	0.003 ***
$CYCLE_{it}$	5998	3.630	0.909	1884	3.667	0.903	4114	3.613	0.916	0.054 **
LEV_{it}	5998	0.245	0.180	1884	0.246	0.169	4114	0.245	0.200	0.001
ICW_{it}	5998	0.032	0.124	1884	0.017	0.216	4114	0.039	0.445	−0.022 **
CG_{it}	5998	0.723	0.155	1884	0.777	0.125	4114	0.698	0.185	0.079 ***
AGE_{it}	5998	3.242	0.759	1884	3.377	0.484	4114	3.180	0.828	0.197 ***
$BIG4_{it}$	5998	0.890	0.198	1884	0.903	0.082	4114	0.884	0.127	0.019 ***
HHI_{it}	5998	0.093	0.012	1884	0.009	0.001	4114	0.131	0.001	−0.122 ***

Notes: Definitions of all of the variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level.

Most of these features are found to be consistent with findings in prior studies in which the focus has tended to be placed primarily on financial firms (Hoyt and Liebenberg 2011; Baxter et al. 2013). The Pearson correlations between the main variables are reported in Table 5, which shows that the measures of ERM, including ERM adoption (ERM_{it}) and ERM scores ($ERMS_{it}$), both have significant correlations with most of the control variables.

Table 5. Pearson correlation matrix.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	
$ADACC_{it}$	1																					
$SMALL_{it}$	2	−0.12																				
MBE_{it}	3	0.01	0.09																			
SD_OCF_{it}	4	0.26	−0.01	0.03																		
SD_RET_{it}	5	0.12	−0.05	−0.02	0.24																	
ERM_{it}	6	−0.05	−0.01	−0.04	−0.12	−0.15																
$ERMS_{it}$	7	−0.05	−0.09	−0.02	−0.13	−0.15	0.73															
$SIZE_{it}$	8	−0.07	0.13	0.07	−0.19	−0.25	0.34	0.33														
ROA_{it}	9	−0.07	0.37	0.15	0.23	0.01	−0.07	−0.04	−0.28													
MTB_{it}	10	0.17	−0.08	0.02	0.26	0.06	0.01	−0.01	−0.05	−0.02												
$LOSS_{it}$	11	0.12	−1.00	−0.09	0.01	0.05	0.01	0.00	−0.06	−0.37	0.08											
VOL_E_{it}	12	0.16	−0.26	−0.04	0.19	0.16	−0.03	−0.06	−0.23	−0.22	0.02	0.26										
VOL_S_{it}	13	0.11	−0.01	0.04	0.27	0.10	−0.13	−0.21	−0.27	0.23	0.01	0.00	0.21									
VOL_C_{it}	14	0.20	−0.08	0.01	0.37	0.21	−0.11	−0.18	−0.31	0.21	0.05	0.08	0.40	0.40								
$\Delta SALES_{it}$	15	0.25	−0.16	−0.01	−0.22	−0.09	0.12	0.08	0.14	−0.21	−0.01	0.16	−0.06	−0.19	−0.13							
$CYCLE_{it}$	16	0.13	−0.03	−0.06	−0.07	−0.02	0.10	0.07	0.23	−0.26	0.12	0.03	−0.03	−0.20	−0.10	0.03						
LEV_{it}	17	−0.12	−0.10	−0.04	−0.15	−0.07	−0.01	0.02	0.12	−0.07	0.13	0.10	−0.01	−0.09	−0.08	0.05	−0.07					
ICW_{it}	18	−0.01	−0.07	−0.07	−0.01	0.01	−0.05	−0.24	−0.07	−0.08	−0.02	0.07	0.03	−0.02	−0.01	0.00	0.04	0.09				
CG_{it}	19	−0.06	−0.07	−0.05	−0.07	−0.11	0.19	0.15	0.28	0.05	0.01	−0.04	−0.03	−0.06	−0.06	0.05	0.06	−0.03	−0.07			
AGE_{it}	20	−0.14	0.06	−0.01	−0.20	−0.17	0.25	0.22	0.37	−0.05	−0.04	−0.06	−0.13	−0.16	−0.19	0.09	0.09	0.07	−0.02	0.05		
$BIG4_{it}$	21	−0.09	0.02	0.01	−0.05	−0.12	0.05	0.01	0.12	0.01	−0.02	−0.02	0.01	−0.01	0.00	0.05	0.01	0.06	−0.01	−0.01	0.07	
HHI_{it}	22	0.05	−0.01	0.00	−0.01	−0.01	−0.02	−0.03	0.01	0.06	0.00	0.01	−0.02	0.07	0.001	0.02	−0.15	0.05	0.02	−0.05	−0.07	0.14

Note: Figures reported in bold text indicate strong ($p < 0.01$) levels of significance, while figures reported in italics indicate weak ($p < 0.05$ or $p < 0.1$) levels of significance.

5. Empirical Results and Discussion

5.1. Main Empirical Results

In our initial analysis, we investigated the relationship between the effects of ERM and the alternative measures of financial reporting quality. The results of regressing the magnitude of performance-adjusted discretionary accruals ($ADACC_{it}$) on the ERM measures ERM_{it} and $ERMS_{it}$ are, respectively, presented in Models (1) and (2) of Table 6. When all of the other control variables and fixed effects are included, the estimated coefficient on ERM_{it} ($ERMS_{it}$) is found to be significantly negative, at $−0.025$ ($−0.019$), thereby suggesting that the adoption and better implementation of ERM is associated with a lower magnitude of discretionary accruals and better financial reporting quality.

Table 6. Regressions of discretionary accruals, small earnings, and earnings surprises on ERM.

Dependent Variable:	<i>ADACC_{it}</i>				<i>SMALL_{it}</i>				<i>MBE_{it}</i>			
	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)	
Variables	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	χ^2 -Stat	Coeff.	χ^2 -Stat	Coeff.	χ^2 -Stat	Coeff.	χ^2 -Stat
<i>ERM_{it}</i>	−0.025 ***	(−2.67)	−0.019 ***	(−2.66)	−0.053 ***	[3.97]	−0.101 **	[5.46]	−0.134 **	[4.22]	−0.036 **	[5.87]
<i>ERMS_{it}</i>	−0.099 **	(−2.13)	−0.089 *	(−2.18)	−0.151 ***	[25.38]	−0.156 ***	[26.99]	−0.054 ***	[9.40]	−0.049 ***	[7.86]
<i>ROA_{it}</i>	−0.034 ***	(−3.03)	−0.035 ***	(−3.07)	−0.564 ***	[17.18]	−0.576 ***	[17.48]	−0.189 ***	[68.67]	−0.191 ***	[60.32]
<i>MTB_{it}</i>	0.005 ***	(−4.27)	0.005 ***	(−4.22)	−0.003	[1.10]	−0.004	[1.21]	0.005 *	[2.78]	0.005	[1.89]
<i>LOSS_{it}</i>	0.012 ***	(−3.9)	0.012 ***	(−3.94)								
<i>VOL_S_{it}</i>	0.008 ***	(−5.85)	0.008 ***	(−5.8)	0.033	[1.56]	0.034	[1.62]	0.012	[0.60]	0.013	[0.66]
<i>VOL_C_{it}</i>	0.005 ***	(−4.25)	0.007 **	(−2.37)	−0.048 ***	[18.30]	−0.050 ***	[19.72]	−0.018 ***	[7.41]	−0.018 ***	[7.37]
$\Delta SALES_{it}$	0.041 ***	(−5.04)	0.041 ***	(−5.05)	−0.874 ***	[32.55]	−0.885 ***	[33.26]	0.137	[1.30]	0.099	[1.26]
<i>CYCLE_{it}</i>	0.005 ***	(−4.97)	0.005 ***	(−5.03)	0.035	[0.93]	0.033	[0.80]	0.01	[0.17]	0.011	[0.24]
<i>LEV_{it}</i>	−0.027 ***	(−5.33)	−0.027 ***	(−5.28)	−0.109 **	[5.37]	−0.110 **	[5.15]	−0.398 ***	[11.90]	−0.400 ***	[12.04]
<i>ICW_{it}</i>	0.004 *	(−1.92)	0.004 *	(−1.92)	0.024	[2.20]	0.023	[2.15]	0.015 *	[2.98]	0.014 *	[3.07]
<i>CG_{it}</i>	−0.011 *	(−1.95)	−0.011 *	(−1.92)	−0.021 **	[3.97]	−0.019 **	[4.02]	−0.095 **	[3.94]	−0.058 *	[3.78]
<i>AGE_{it}</i>	−0.008 ***	(−6.27)	−0.008 ***	(−6.30)	−0.06	[1.95]	−0.067 **	[1.98]	−0.058 **	[3.71]	−0.060 **	[3.94]
<i>BIG4_{it}</i>	−0.058 *	(−1.71)	−0.051 *	(−1.73)	−0.239 *	[3.45]	−0.236 *	[3.48]	−0.054 *	[3.75]	−0.066 **	[3.79]
<i>HHI_{it}</i>	0.242 ***	(−3.32)	0.249 ***	(−3.35)	−0.356	[1.76]	−0.356	[1.75]	−0.257	[1.49]	−0.191	[1.29]
Fixed Effect	Industry		Industry		Industry		Industry		Industry		Industry	
	Year		Year		Year		Year		Year		Year	
Model	OLS		OLS		Logistic		Logistic		Logistic		Logistic	
No. of Obs	5998		5998		5998		5998		5998		5998	
Adj/Pseudo R ²	0.174		0.178		0.249		0.25		0.052		0.051	

Notes: Definitions of all of the variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level. The t-statistics and Wald χ^2 statistics are based on robust standard errors clustered at firm level.

The coefficients on most of the other control variables are found to be significant and consistent with both our expectations and the findings in the extant literature (Doyle et al. 2007). Firms with higher growth potential (*MTB_{it}*), a net loss (*LOSS_{it}*), higher volatility in prior performance (*VOL_S_{it}* and *VOL_C_{it}*), higher growth in current sales ($\Delta SALES_{it}$), longer operating cycles (*CYCLE_{it}*), and internal control weakness (*ICW_{it}*) are associated with lower financial reporting quality (higher discretionary accruals). Conversely, firms that are larger in size (*SIZE_{it}*), with better operating performance (*ROA_{it}*), stronger corporate governance (*CG_{it}*), longer history (*AGE_{it}*), and have big four accounting firms as their external auditors (*BIG4_{it}*) are associated with better financial reporting quality (lower discretionary accruals) since the incentives for these firms to increase their income or manipulate their earnings through discretionary accruals should be weaker.

The Herfindahl index (*HHI_{it}*) is a proxy for the intensity of competition within an industry, with a higher value indicating that only a few firms account for a significant proportion of the market share, whilst a lower value indicates that many firms account for the lion's share of the market. A positive coefficient on *HHI_{it}* implies that competition, which increases the information available to the principal (the owner of the firm), thereby enabling a better monitoring mechanism placed on the agent (the manager), contributes to better financial reporting quality.

We also present the summary statistics from the logistic regressions of small positive income (*SMALL_{it}*) and meeting or beating analyst earnings forecasts (*MBE_{it}*) on ERM implementation. The *LOSS_{it}* control variable is excluded from the models since it has a mechanical negative correlation with small profits. The estimated coefficients on *ERM_{it}* (−0.053) in Model (3) and *ERMS_{it}* (−0.101) in Model (4) of Table 6 are found to be significantly negative at the 5% level or better, which suggests that ERM implementation reduces the likelihood of reporting small positive income levels. The estimated coefficients on *ERM_{it}* (−0.134) in Model (5) and *ERMS_{it}* (−0.036) in Model (6) of Table 6 are both found to have a significantly negative association with *MBE_{it}*, thereby indicating a reduced likelihood of meeting or beating analyst earnings forecasts when ERM is implemented. Most of the controls are significant and consistent with our expectations.

The results reported in Table 6 provide overall support for H1, which posits that the implementation of an ERM program is associated with better financial reporting quality. Since ERM takes a holistic approach to the conceptualization and management of all types of risks in a systematic way, ERM program implementation should help managers identify different risks and evaluate their potential effects, including the consequences of earnings management or deterioration in financial reporting quality (such as loss of reputation, impairment of reporting credibility, and higher costs of capital, along with other potential negative effects).

Managers may, therefore, decide to change their reporting incentives in order to improve their financial reporting quality. There may, however, be an alternative explanation for the findings, essentially relating to endogeneity; that is, if managers are risk-averse by nature, despite the fact that they may be more willing to adopt ERM, their innate incentives for faithful representation can simultaneously lead to high-quality financial reporting, regardless of any ERM effects.

Table 7 presents the results of the effects of ERM implementation on the future operational performance of a firm. The estimated coefficients on ERM_{it} (−0.068) in Model (1) and $ERMS_{it}$ (−0.050) in Model (2) of Table 7 are both found to have significantly negative associations with the standard deviation in net operating cash flows in the subsequent three-year period (SD_OCF_{it}). We use SD_OCF_{it} as a proxy for the volatility of a firm's future operations because net operating cash flow is a summary measure of firm performance 'uncontaminated' by discretionary accruals or other non-recurring activities. The results suggest that ERM can lower the volatility of future operations, thereby providing support for H2.

Table 7. Regressions of future operational measures on ERM.

Dependent Variable:	SD_OCF_{it}				SD_RET_{it}			
	Model (1)		Model (2)		Model (3)		Model (4)	
Variables	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat	Coeff.	t-Stat
ERM_{it}	−0.068 ***	(−2.82)			−0.107 ***	(−4.99)		
$ERMS_{it}$			−0.050 ***	(−2.69)			−0.161 ***	(−4.15)
$SIZE_{it}$	−0.037 *	(−1.79)	−0.032 *	(−1.75)	−0.055 ***	(−4.93)	−0.056 ***	(−5.00)
ROA_{it}	0.063 ***	(5.03)	0.066 ***	(5.26)	−0.109	(−1.57)	−0.089	(−1.28)
MTB_{it}	0.005 ***	(4.89)	0.005 ***	(4.78)	0.018 ***	(2.99)	0.018 ***	(2.97)
$LOSS_{it}$	0.004	(1.49)	0.005	(1.59)	0.008 ***	(4.84)	0.008 ***	(4.96)
VOL_E_{it}	0.003 ***	(5.15)	0.003 ***	(5.12)	0.003 *	(1.74)	0.003 *	(1.69)
VOL_C_{it}	0.046 ***	(6.86)	0.045 ***	(6.61)	0.015 ***	(9.94)	0.014 ***	(9.66)
$\Delta SALES_{it}$	0.026 ***	(7.35)	0.027 ***	(7.44)	0.059 ***	(3.03)	0.061 ***	(3.09)
$CYCLE_{it}$	0.001	(0.12)	0.003	(0.29)	0.009	(1.59)	0.009	(1.63)
LEV_{it}	−0.024 ***	(4.70)	−0.024 ***	(4.57)	−0.013 ***	(4.64)	−0.013 ***	(4.47)
ICW_{it}	0.033 *	(1.84)	0.004 *	(1.81)	0.057 **	(2.37)	0.056 **	(2.34)
CG_{it}	−0.012 **	(2.03)	−0.007 **	(2.13)	−0.005 *	(1.80)	−0.006 **	(2.10)
AGE_{it}	−0.005 ***	(3.98)	−0.005 ***	(4.09)	−0.005 ***	(6.88)	−0.005 ***	(7.06)
$BIG4_{it}$	0.004	(0.39)	0.002	(0.2)	−0.032 ***	(5.68)	−0.034 ***	(5.90)
Fixed Effect	Industry		Industry		Industry		Industry	
Model	Year		Year		Year		Year	
No. of Obs	OLS		OLS		OLS		OLS	
Adj/Pseudo R ²	4557		4557		4557		4557	
	0.275		0.277		0.15		0.148	

Notes: Definitions of all of the variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level. The t-statistics are based on robust standard errors clustered at firm level.

We also use the standard deviation in future stock returns, SD_RET_{it} , as an alternative measure of future economic outcomes from a market perspective and examine its relationship with ERM. The estimated coefficients on ERM_{it} (−0.107) in Model (3) and $ERMS_{it}$ (−0.161) in Model (4) of Table 7 are both found to be significantly negative at the 1% level, thereby suggesting that ERM implementation is related to a decline in volatility in future firm performance.

These findings are consistent with the findings reported above on the volatility of future net operating cash flows and, therefore, provide further support for H2. The benefit of lowering a firm's operational and financial reporting risks through ERM can be reflected in firm value, and indeed, investors may also regard ERM implementation as a positive signal leading to more consistent valuations of the firm.¹⁶

Table 8 reports the mean values of the dependent variables for ERM adopters and non-adopters in the pre- and post-SEC final rule periods, which regulated the requirement for the enhanced disclosure of risk oversight information. The financial reporting quality proxies, including the mean magnitude of discretionary accruals, $ADACC_{it}$, and the indicator of small positive income levels, $SMALL_{it}$, were initially found to be lower for ERM adopters, with the gap being found to have increased in the post-SEC final rule period. For example, whilst $ADACC_{it}$ was found to be 0.046 for ERM adopters in the pre-SEC final rule period, this was reduced to 0.032 in the post-rule period.

Table 8. Univariate difference-in-differences analysis of risk oversight disclosure requirement.

Variables	Pre-2010 (a)	Post-2010 (b)	Difference (b) – (a)
$ADACC_{it}$			
(i) $ERM_{it} = 1$ (N = 1884)	0.046	0.032	−0.014 **
(ii) $ERM_{it} = 0$ (N = 4114)	0.062	0.053	−0.009 **
Difference (i) – (ii)	−0.016 ***	−0.021 ***	−0.005 **
$SMALL_{it}$			
(i) $ERM_{it} = 1$ (N = 1884)	0.128	0.017	−0.111 ***
(ii) $ERM_{it} = 0$ (N = 4114)	0.179	0.106	−0.073 ***
Difference (i) – (ii)	−0.051 ***	−0.089 ***	−0.038 ***
MBE_{it}			
(i) $ERM_{it} = 1$ (N = 1884)	0.319	0.271	−0.048 ***
(ii) $ERM_{it} = 0$ (N = 4114)	0.286	0.274	−0.012 **
Difference (i) – (ii)	0.033 ***	−0.003 **	−0.036 ***
SD_OCF_{it}			
(i) $ERM_{it} = 1$ (N = 1663)	0.046	0.037	0.009 **
(ii) $ERM_{it} = 0$ (N = 2894)	0.064	0.062	−0.002
Difference (i) – (ii)	−0.018 **	−0.025 ***	−0.007 **
SD_RET_{it}			
(i) $ERM_{it} = 1$ (N = 1663)	0.010	0.009	−0.001 *
(ii) $ERM_{it} = 0$ (N = 2894)	0.043	0.046	0.003 **
Difference (i) – (ii)	−0.033 ***	−0.037 ***	−0.004 **

Note: The SEC final rule (33-9089) came into effect on 28 February 2010. Definitions of all of the variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level.

Although a similar trend is observed for ERM non-adopters (from 0.062 to 0.053 in the pre- to post-SEC final rule periods), based upon the *t*-tests comparing the changes across the two groups, the reduction is found to be significantly larger (by 0.005) for ERM adopters. The mean proportion of meeting or beating analyst earnings forecasts (MBE_{it}) in the pre-SEC final rule period was 0.319 for ERM adopters, which was larger than that for ERM non-adopters, at 0.286. Although this result is inconsistent with our expectations, the mean value for ERM adopters was reduced to 0.048 in the post-SEC final rule period, with the decrease again being significantly larger than that for ERM non-adopters.

A similar picture is also provided by the proxies of future operational performance. The reductions in the mean volatility of future operating cash flows and future stock returns between the pre- and post-SEC final rule periods are significantly larger for ERM adopters,

at the 5% significance level, as compared to non-adopters. Overall, the univariate results help to illustrate the effects of an ERM program in the pre- and post-SEC final rule periods and, hence, provide support for H3a and H3b.

The results of the difference-in-differences analysis are presented in Table 9, where the estimated coefficients on the indicator of ERM implementation, ERM_{it} , are found to be significantly negative across all models at the 10% significance level or better, which implies better financial reporting quality and lower future operational volatility for ERM adopters over the sample period. The estimated coefficients on the post-SEC final rule period indicator ($POST_{it}$) are significantly positive in Models (3) to (5), indicating a higher probability of meeting or beating analyst earnings forecasts and higher volatility in the future performance of the firms in terms of their operating cash flows and stock returns after 2010 across the board.

Table 9. Difference-in-differences analysis of ERM effects around risk oversight disclosure requirement.

Dependent Variables: Variables	Exp. Sign	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
		$ADACC_{it}$ Coeff.	t-Stat	$SMALL_{it}$ Coeff.	χ^2 -Stat	MBE_{it} Coeff.	χ^2 -Stat	SD_OCF_{it} Coeff.	t-Stat	SD_RET_{it} Coeff.	t-Stat
$POST_{it}$	?	0.016	(−1.27)	−0.261	[2.10]	0.196 **	[4.35]	0.034 ***	(−5.65)	0.035 ***	(−3.82)
ERM_{it}	−	−0.021 *	(−1.68)	−0.114 **	[6.59]	−0.126 *	[3.63]	−0.018 ***	(−2.68)	−0.014 ***	(−4.87)
$POST_{it} \times ERM_{it}$	?	−0.009 ***	(−3.21)	0.036	[1.56]	−0.053 ***	[9.52]	−0.012	(−1.77 *)	−0.010 **	(−2.06)
Control Variables		Included		Included		Included		Included		Included	
Fixed Effect		Industry		Industry		Industry		Industry		Industry	
Model		Year		Year		Year		Year		Year	
No. of Obs		OLS		OLS		Logistic		Logistic		OLS	
Adj/Pseudo R ²		5998		5998		5998		4557		4557	
		0.073		0.125		0.074		0.275		0.151	

Notes: Models (1)–(3) are based upon the modified Equation (1). Models (4) and (5) are based upon the modified Equation (4). Definitions of all of the variables are provided in Table 1, with $POST_{it}$ and $POST_{it} \times ERM_{it}$ being included in each equation; $POST_{it}$ takes the value of 1 if the firm-year is in the post-SEC final rule period; otherwise, 0. The SEC final rule 33-9089 came into effect on 28 February 2010. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level. The t-statistics and Wald χ^2 statistics are based on robust standard errors clustered at firm level.

The estimated coefficients on the interaction term ($POST_{it} \times ERM_{it}$), our main variable of interest, are found to be significantly negative at the 10% level or better for all models, with the one exception of $SMALL_{it}$. The significant moderating effect of the interaction term supports our explanation for the regulatory influence on ERM effectiveness; that is, the associations between ERM implementation, better financial reporting quality, and lower volatility in future operational performance were strengthened by the SEC requirement for enhanced disclosure in risk oversight.

Although our findings further clarify the effects of the SEC disclosure requirement and thereby provide support for Hypotheses 3a and 3b, they could be explained from different standpoints. Firstly, the SEC's final rule on the role of the board in risk oversight may have incentivized firms with greater emphasis on ERM program implementation to include a risk committee on their board. Therefore, as we have observed, a better-implemented ERM program will have a more profound influence on a firm's financial reporting quality and performance.

Secondly, whilst the implementation of ERM was not mandatory in the pre- and post-SEC final rule periods, such regulatory change alters the reporting incentives of the firm with regard to its ERM activities. The 4.27% increase in the ERM adoption rate in 2010 (shown in Table 3) may be partly attributable to non-disclosing adopters in the pre-SEC final rule period. Although their data should not impact the explanatory power of our analysis since it only biases our results toward the null, the proper disclosure of their ERM activities in the post-SEC final rule period would have increased the significance of our results, as suggested by Tables 8 and 9. In summary, our findings on the regulatory

impact have a policy implication since it becomes clear that firms should seriously consider the appropriate implementation of an ERM program and the proper disclosure of their related activities.

5.2. Robustness and Additional Tests

We carried out a series of analyses to alleviate concerns regarding the sample and research design, such as the potential problems of self-selection bias, the overlapping effects between ERM and IC, and the alternative measures of firm performance.

5.2.1. Propensity-Matched Sample

Liebenberg and Hoyt (2003) and Gordon et al. (2009) noted that when measuring a firm's ERM implementation, it was important to take into account any endogenous factors, such as environmental uncertainty or firm characteristics. Whilst an ERM program may improve reporting quality and firm performance, managers who are risk averse may tend to adopt ERM, provide high-quality reports, and make conservative operational decisions anyway, regardless of the effectiveness of ERM.

We, therefore, employ a 'propensity score matched' (PSM) sample to control for the problem of self-selection and then rerun the tests. We follow Gordon et al. (2009) and Baxter et al. (2013) to estimate the propensity score for ERM adoption in each firm-year based on firm size, volatility in prior operating cash flows, leverage, the use of a 'big four' auditor, the Altman (1968) Z-score, the number of geographical segments, and the indicator of foreign transactions. The logistic regression results are reported in Table 10.

Table 10. Logistic regression generating the propensity score-matched sample.

Variables	Expected Sign	Dependent Variable: Pr.(ERM _{it} = 1) Coeff.	χ ² -Stat
SIZE _{it}	+	0.326 ***	[78.67]
VOL _{it}	+	−0.179 **	[4.03]
LEV _{it}	?	−0.033 **	[6.45]
BIG4 _{it}	?	−0.064 *	[3.21]
ZSCORE _{it}	?	0.003 *	[3.18]
SEG _{it}	+	0.134 ***	[15.25]
FOREIGN _{it}	+	0.507 ***	[7.59]
No. of Obs.		5998	
Likelihood ratio (Pr > Chi-square)		782.52 (<0.001)	

Notes: ZSCORE_{it} is the estimated Z-score proposed by Altman (1968); SEG_{it} is the natural logarithm of the number of geographical segments (based upon data from Compustat Segment); and FOREIGN_{it} is an indicator that takes the value of 1 if firm-year has a non-zero foreign currency translation; otherwise, 0. Definitions of all of the other variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level. The Wald χ² statistics are based on robust standard errors clustered at firm level.

For each firm-year with ERM adoption, we identify a non-adopter (sampling without replacement) in the same year with the closest propensity score within a caliper distance of 0.10. This matching procedure ultimately provided us with a sample of 728 firm-year ERM adopters matched with 728 non-adopters to construct a matched sample comprising 1456 observations.¹⁷ The analyses addressing the effects of ERM implementation based on this matched sample are provided in Table 11, from which we can see that the results are consistent with our main findings reported in Tables 6 and 7. The estimated coefficients on the ERM scores, ERM_{it}, are consistently found to be significantly negative, thereby confirming that ERM implementation contributes to better financial reporting quality and lower future operational volatility.¹⁸

Table 11. Propensity score-matched regressions of financial reporting quality and future operational measures on ERM with self-selection controls.

Dependent Variables: Variables	Exp. Sign	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
		<i>ADACC_{it}</i> Coeff.	t-Stat	<i>SMALL_{it}</i> Coeff.	χ^2 -Stat	<i>MBE_{it}</i> Coeff.	χ^2 -Stat	<i>SD_OCF_{it}</i> Coeff.	t-Stat	<i>SD_RET_{it}</i> Coeff.	t-Stat
<i>ERMS_{it}</i>	+ / −	−0.069 **	(−2.09)	−0.026 *	[3.61]	−0.242 **	[7.04]	−0.034 ***	(−2.65)	−0.159 **	(−2.26)
Control Variables		Included		Included		Included		Included		Included	
Fixed Effect		Industry		Industry		Industry		Industry		Industry	
Model		OLS		OLS		Logistic		Logistic		OLS	
No. of Obs		1456		1456		1456		1456		1456	
Adj/Pseudo R ²		0.172		0.237		0.079		0.271		0.144	

Notes: The regression results are based upon a sample of 728 firm-year observations of ERM adopters matched with 728 ERM non-adopters. Models (1)–(3) are based on the modified Equation (1). Models (4) and (5) are based on the modified Equation (4). Definitions of all of the variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level. The t-statistics and Wald χ^2 statistics are based on robust standard errors clustered at firm level.

5.2.2. Strategic Effects of ERM

Doyle et al. (2007) found that effective IC helped to improve firms' financial reporting quality. However, whilst IC and ERM share common objectives in terms of reporting, operating, and compliance, the two frameworks are quite distinct and have different emphases (COSO 2017); that is, ERM and IC should individually contribute to financial reporting quality and firm operations. Nevertheless, since ERM is much broader and more conceptualized, with a specific focus at a strategic level and considering both upside and downside risks, it should be applied from strategy through to execution with reliance on IC at critical junctures (Chesley et al. 2016).

We, therefore, attempt to disentangle the strategic effects of ERM and emphasize the incremental contribution of ERM as compared to IC. We regress the ERM scores (*ERMS_{it}*) on the proxies of the shared objectives of ERM and IC, as follows:

$$ERMS_{it} = SALES_{it} + \Delta SALES_{it} + ICW_N_{it} + RESTATE_{it} + AFEE_{it} + AC_IND_{it} + AC_EXP_{it} + \varepsilon_{it} \quad (5)$$

The explanatory variables are separated into three groups based on the common objectives of ERM and IC defined in the COSO-related frameworks. Firstly, our operational proxies include the turnover of assets (*SALES_{it}*, calculated as total sales deflated by average total assets) and the percentage change in sales ($\Delta SALES_{it}$). Secondly, the reporting effects variables include the number of IC weaknesses (*ICW_N_{it}*) and an indicator (*RESTATE_{it}*), which takes the value of 1 for restatements; otherwise, 0. Consistent with the notion that a higher value represents better reporting, we transform the two variables by timing (−1) on both variables. Thirdly, compliance is measured by audit fees (*AFEE_{it}*) and the attributes of the audit committee.

Whilst Hines et al. (2015) identified a positive association between audit fees and the presence of a board-level risk committee, Krishnan (2005) found that independent audit committees and those committees with financial expertise had significant associations with better IC quality, but this was not the case for the size of the audit committees. We, therefore, include audit committee independence (*AC_IND_{it}*) and audit committee financial expertise (*AC_EXP_{it}*) in our model. *AC_IND_{it}* is defined as the proportion of independent directors on the audit committee, and *AC_EXP_{it}* is the number of audit committee members with financial expertise.

The empirical results of Equation (5) are presented in Appendix B. Consistent with our expectations, all of the proxy variables are found to be positively associated with ERM scores at the 10% level or better, thereby suggesting that ERM encompasses the operational, reporting, and compliance objectives, which are also the objectives of IC. The residual term

of this model is used to construct $ERMI_{it}$, which is used to capture the strategic effects of ERM. When the ERM score is 0, there is no ERM implementation in the firm-year; thus, $ERMI_{it}$ is set at 0 for such cases.

We use $ERMI_{it}$ as an alternative ERM measure in Equations (1) and (4) to carry out further analyses. The results on the strategic effects of ERM are reported in Table 12. Consistent with the main analyses, the estimated coefficients on $ERMI_{it}$ are found to have significantly negative associations with all of the measures of reporting quality and future operational volatility at the 5% level or better, thereby indicating the effects of ERM beyond IC at the strategic level.

Table 12. Regressions of financial reporting quality and future operation measures on the strategic effects of ERM.

Dependent Variables: Variables	Exp. Sign	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)	
		$ADACC_{it}$ Coeff.	t-Stat	$SMALL_{it}$ Coeff.	χ^2 -Stat	MBE_{it} Coeff.	χ^2 -Stat	SD_OCF_{it} Coeff.	t-Stat	SD_RET_{it} Coeff.	t-Stat
$ERMI_{it}$	+ / −	−0.025	(−2.70)	−0.071 **	[4.17]	−0.037 **	[3.88]	−0.027 ***	(−2.76)	−0.132 ***	(−3.13)
Control Variables		Included		Included		Included		Included		Included	
Fixed Effect		Industry		Industry		Industry		Industry		Industry	
Model		Year		Year		Year		Year		Year	
No. of Obs		OLS		OLS		Logistic		Logistic		OLS	
Adj/Pseudo R ²		5998		5998		5998		4557		4557	
		0.178		0.249		0.051		0.274		0.145	

Notes: The regression results are based on the full sample. Models (1)–(3) are based on the modified Equation (1). Models (4) and (5) are based on the modified Equation (4). Definitions of all of the variables are provided in Table 1. *** indicates two-sided statistical significance at the 1% level; ** indicates significance at the 5% level. The t-statistics and Wald χ^2 statistics are based on robust standard errors clustered at firm level.

We also carry out an additional test to determine the robustness of the main results, individually examining the effects of the three ERM factors specified in Section 3.1 in order to construct an ERM completeness score, $ERMS_{it}$. We rerun the regressions individually employing the following three alternative ERM component variables: (i) a dummy variable, $ERM_HOLISTIC_{it}$, which identifies whether a firm uses synonymous terms to disclose its ERM program, including holistic, integrated, or consolidated approaches, techniques, and risk management strategies; (ii) a dummy variable, ERM_CRO_{it} , which identifies whether a firm sets up a specific risk management role within the senior management team, such as a CRO, a Chief Compliance and Risk Officer, or other similar position; and (iii) a dummy variable, ERM_RC_{it} , which identifies whether a firm includes an independent committee on the board to oversee the firm's risk management policies and framework.

The results of this robustness check are reported in Table 13. Overall, the findings are consistent with our main results, providing support for the effectiveness of the use of the three ERM components for the construction of our main ERM test variable, $ERMS_{it}$. Of the three ERM components, the inclusion of an independent risk committee on the board, ERM_RC_{it} , carries the strongest explanatory power for both reporting quality and firm operations.

Table 13. Regressions on financial reporting quality and future operations measures on individual components of the ERM completeness measure.

Dependent Variables: Variables	Model (1) <i>ADACC_{it}</i>		Model (2) <i>SMALL_{it}</i>		Model (3) <i>MBE_{it}</i>		Model (4) <i>SD_OCF_{it}</i>		Model (5) <i>SD_RET_{it}</i>	
	Coeff.	t-Stat	Coeff.	χ^2 -Stat	Coeff.	χ^2 -Stat	Coeff.	t-Stat	Coeff.	t-Stat
Panel A: Holistic ERM approach <i>ERM_HOLISTIC_{it}</i>	−0.07	(−1.45)	−0.122 *	[2.74]	−0.076 *	[2.79]	−0.044 **	(−2.19)	−0.002 *	(−1.86)
Adj/Pseudo R ²	0.177		0.25		0.052		0.269		0.15	
Panel B: Risk management appointments <i>ERM_CRO_{it}</i>	−0.003	(−1.12)	−0.220 **	[5.95]	−0.029	[1.95]	−0.010 ***	(−4.17)	−0.003 **	(−2.38)
Adj/Pseudo R ²	0.173		0.25		0.072		0.277		0.145	
Panel C: Independent risk committee <i>ERM_RC_{it}</i>	−0.005 ***	(−2.72)	−0.218 **	[5.13]	−0.074 ***	[7.54]	−0.008 ***	(−2.77)	−0.003 *	(−1.70)
Adj/Pseudo R ²	0.174		0.252		0.051		0.27		0.144	
Across All Panels: Control Variables Fixed Effect	Included		Included		Included		Included		Included	
Model	Industry Year OLS		Industry Year OLS		Industry Year Logistic		Industry Year Logistic		Industry Year OLS	

Notes: Models (1)–(3) are based on the modified Equation (1). Models (4) and (5) are based on the modified Equation (4). The dummy variables are described as follows: *ERM_HOLISTIC_{it}* takes the value of 1 if the firm uses synonymous terms to disclose its adoption of an ERM program or the implementation of holistic, integrated, or consolidated risk management approaches, techniques, and strategies; otherwise, 0. *ERM_CRO_{it}* takes the value of 1 if the firm sets up a specific risk management role in its senior management team (such as a CRO, Chief Compliance and Risk Officer, or other similar position); otherwise, 0. *ERM_RC_{it}* takes the value of 1 if the firm sets up an independent risk committee on the board to oversee its risk management policies and framework; otherwise, 0. *** indicates statistical significance at the 1% level; ** indicates statistical significance at the 5% level; and * indicates statistical significance at the 10% level. The t-statistics and Wald χ^2 statistics are based upon robust standard errors clustered at firm level.

Finally, we carry out a sub-sample test on industries commonly regarded as having a high level of uncertainty due to their industry characteristics. As discussed in Section 2, an effective ERM program is expected to help firms understand and assess their enterprise-wide risk from a holistic standpoint, in particular, aligning the firm's operational activities with its strategic planning. Firms pursuing innovation and/or operating in a changing industry have to strategize their business operations with greater risk awareness when competing in such a volatile business environment in order to prepare managers for the uncertain challenges that they will face in their decision-making relating to resource allocation. As such, effective ERM implementation could be a critical pillar for planning and managing foreseeable risks arising from such resource allocation decisions, as well as coping with changes in the external environment.

In order to test the robustness of the effects of ERM for firms with such business characteristics, we employ the Fama–French industry classification to extract firms from two sample industries, the software and pharmaceutical industries. The results reported in Table 14 remain quantitatively similar to our main findings. In particular, we find that ERM has a significant effect on the future operational performance of the firms, which again provides support for the notion that ERM is of strategic value in managing uncertainty for better performance.

Taken together, the results suggest that firms operating in a highly uncertain business environment can leverage an ERM program to address and manage the risks resulting from the strategic investment choices of firms and the level of volatility within a given industry.

Table 14. Regressions on financial reporting quality and future operations measures on high-risk industry sub-samples.

Dependent Variables: Variables	Model (1) <i>ADACC_{it}</i>		Model (2) <i>SMALL_{it}</i>		Model (3) <i>MBE_{it}</i>		Model (4) <i>SD_OCF_{it}</i>		Model (5) <i>SD_RET_{it}</i>	
	Coeff.	t-Stat	Coeff.	χ^2 -Stat	Coeff.	χ^2 -Stat	Coeff.	t-Stat	Coeff.	t-Stat
Panel A: Software industry (N = 192)										
<i>ERMS_{it}</i>	−0.010 *	(−1.66)	−0.185	[1.42]	−0.32	[2.14]	−0.016 ***	(−6.05)	−0.007 **	(−2.08)
Adj/Pseudo R ²	0.433		0.504		0.229		0.485		0.325	
Panel B: Pharmaceutical industry (N = 209)										
<i>ERMS_{it}</i>	−0.003	(−1.84)	−0.66	[2.37]	−0.192 **	[3.69]	−0.010 ***	(−3.24)	−0.004 **	(−2.67)
Adj/Pseudo R ²	0.358		0.515		0.239		0.622		0.507	
Across All Panels: Control Variables Fixed Effect	Included		Included		Included		Included		Included	
Model	Industry Year OLS		Industry Year OLS		Industry Year Logistic		Industry Year Logistic		Industry Year OLS	

Notes: Models (1)–(3) are based on the modified Equation (1). Models (4) and (5) are based on the modified Equation (4). *ERMS_{it}* is as defined in Table 1. *** indicates statistical significance at the 1% level; ** indicates statistical significance at the 5% level; and * indicates statistical significance at the 10% level. The t-statistics and Wald χ^2 statistics are based upon robust standard errors clustered at firm level.

5.2.3. Alternative Measures of Firm Performance

Various prior studies on ERM have identified associations between the adoption and/or quality of ERM using alternative performance measures, such as Tobin's Q (Hoyt and Liebenberg 2011; Baxter et al. 2013), return on assets (Lin et al. 2013), and earnings volatility (Edmonds et al. 2015). We also use these measures as alternative dependent variables to rerun Equation (4). We regress *ERMS_{it}* on (i) one-year-ahead Tobin's Q, which is measured as the sum of the market value of equity and the book value of total liabilities deflated by the book value of total assets, (ii) one-year-ahead return on assets (ROA), and (iii) future earnings volatility, which is defined as the standard deviation of income before extraordinary items in the subsequent three-year period deflated by average total assets.

The estimated (non-tabulated) coefficients on *ERMS_{it}* are 0.026 (t-value: 4.08) for Tobin's Q, 0.012 (t-value: 3.27) for ROA, and −0.030 (t-value: −2.53) for future earnings volatility, which suggests that ERM implementation can indeed contribute to better firm performance, higher returns on assets, and lower levels of volatility in future earnings. In summary, our results, based upon the use of a sample across multiple industries and years, provide general confirmation of the findings in the prior studies.

6. Conclusions

This study examines the roles of ERM, a holistic program aimed at identifying, conceptualizing, and managing all types of risks in financial reporting and firm operations. Integrated throughout an organization, an ERM framework is geared to improve decision-making in governance, strategy, objective-setting, and day-to-day operations (COSO 2017). We contribute to the literature by demonstrating that ERM is associated with higher financial reporting quality and lower volatility in future operations. By employing a large-scale panel dataset across industries, we provide a comprehensive understanding of the value of ERM, shedding particular light on the strategic value of ERM and the regulatory impact of ERM implementation.

Following the notion that ERM is applied from strategy to operational level (Chesley et al. 2016), we explain these findings based upon two specific channels relating to the strategic objectives of ERM: (i) the alignment of reporting and strategic risks through ERM influences the reporting incentives of managers to improve information quality, enabling investors to assess the value of a firm in a comprehensive way; and (ii) the alignment of operational and strategic risks through ERM helps managers to choose a

conservative process of operations, which leads to lower volatility in future performance whilst simultaneously providing higher financial reporting quality.

Since the implementation of an ERM program is not mandatory and is also time-consuming, we further investigate whether the long-term effects of ERM are driven by exogenous events, such as regulatory change. We find that the associations between ERM, higher reporting quality, and lower volatility in future performance were boosted by the introduction of the SEC final rule (33-9089), which required improved disclosure in risk oversight. We attribute this to two specific aspects. Firstly, the SEC final rule may have been responsible for encouraging the implementation and development of ERM, leading to better ERM effects, and secondly, the final rule is likely to have led to improvements in the disclosure of ERM information. Based upon the second aspect, ERM would clearly become more observable, even if there were no improvements in its effect or implementation rate. In summary, the implication of these findings is that regulators and firms should simultaneously weigh their disclosure and ERM content when implementing or developing an ERM program.

Overall, the results of our study highlight the importance of ERM implementation for practitioners. The findings suggest that effective ERM implementation can not only improve financial reporting quality that contributes to firm value but also help to better gauge operational strategies and adjust resource allocation promptly in response to unexpected disruptions to firm operations. While the results are informative, a couple of caveats remain. Firstly, we were unable to provide direct evidence of the various ways in which an ERM framework improves reporting quality and firm operations. ERM may enable firms to better identify risk and reduce management reporting incentives, thereby improving overall reporting quality. Alternatively, even if ERM has no direct effect on management reporting incentives, it may influence the operational decisions of managers, thereby naturally influencing the reported amounts. Secondly, although we followed prior studies and used multiple thresholds to measure ERM implementation, they may not reflect the actual quality or completeness of ERM. Thirdly, we focused on the long-term effects of ERM, with firms with less experience in ERM implementation excluded from the sample since the results may have been influenced if these firms had been included. Fourthly, since we conducted a manual search for collecting ERM implementation from corporate disclosures, our sample period only covered the period between 2004 and 2014. The research period considered significant developments in IC and ERM, such as COSO's release of the ERM framework (COSO 2004) and IC framework (COSO 2013), the release of the SEC final ruling (2010) that enhanced disclosure of risk oversight, and the global financial crisis (2008) which generated greater demand for risk management. Considering these significant events that influence the implementation of ERM practices, we believe the empirical results of the study continue to shed light on the impact of ERM adoption on firm operations and reporting practices. With the widespread adoption of ERM in recent years and the occurrence of recent unexpected global crises (e.g., the pandemic causing supply chain challenges for firms' operations), future research could expand our study by incorporating more recent data to examine whether the impact of ERM implementation of firm operations and reporting practices remain consistent.

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Appendix A. Examples of Enterprise Risk Management (ERM) Disclosures

Appendix A.1. Pitney Bowes Inc. (CIK: 0000078814, Filing Date: 2010/02/26, Form: 10-K, p. 5)

Item 1A: Risk Factors

“In addition to other information and risk disclosures contained in this Form 10-K, the risk factors discussed in this section should be considered in evaluating our business. We work to manage and mitigate these risks proactively, including through our use of an enterprise risk management program. In our management of these risks, we also evaluate the potential for additional opportunities to mitigate these risks”.

Appendix A.2. United States Steel Corp (CIK: 0001163302, Form: 10-K, 2013/02/15, pp. 53–54)

Item 4: Mine Safety Disclosure

The information concerning mine safety violations and other regulatory matters required by Section 150 of the Dodd–Frank Wall Street Reform and Consumer Protection Act (“the Act”) and Item 104 of Regulation S-K is included in Exhibit 95 to this Form 10-K. EXECUTIVE OFFICERS (EOs) OF THE REGISTRANT.

Table A1. The executive officers of US Steel and their ages as of 1 February 2013 are as follows.

Name	Age	Title	EO Since
George F. Babcoke	56	Senior Vice President—Europe and Global Operations Services	1 March 2008
Larry T. Brockway	53	Senior Vice President and Chief Risk Officer	1 August 2011
James D. Garraux	60	General Counsel and Senior Vice President—Corporate Affairs	1 February 2007

Appendix A.3. INTL FCStone Inc. (CIK: 0000913760, Form: 10-K, 2014/09/30, p. 14)

Business Risks

We have a defined risk policy administered by our risk management committee, which reports to the risk committee of our board of directors. We established specific exposure limits for inventory positions in every business, as well as specific issuer limits and counterparty limits. We designed these limits to ensure that in a situation of unexpectedly large or rapid movements or disruptions in one or more markets, systemic financial distress, the failure of a counterparty or the default of an issuer, the potential estimated loss will remain within acceptable levels. The risk committee of our board of directors reviews the performance of the risk management committee on a quarterly basis to monitor compliance with the established risk policy.

Appendix B

Table A2. ERM Score Regressions on Internal Control Proxies.

Variables	Expected Sign	Dependent Variable: $ERMS_{it}$	
		Coeff.	t-Stat.
$SALES_{it}$	+	0.085	2.56 **
$\Delta SALES_{it}$	+	0.017	5.33 ***
ICW_N_{it}	+	0.109	2.29 **
$RESTATE_{it}$	+	0.019	7.97 ***
$AFEE_{it}$	+	0.014	7.08 ***
AC_IND_{it}	+	0.087	1.87 *
AC_EXP_{it}	+	0.044	5.79 ***
F-value		32.57	
Adj- R^2		0.189	
No. of Obs.		5998	

The strategic effects of ERM were estimated using the residual term of the model, $ERMI_{it}$. The data on AC_IND_{it} and AC_EXP_{it} were retrieved from the Thomas Reuters' ASSET4 database. All of the other variables are as defined in Table 1. The t-statistics are based upon robust standard errors clustered at firm level. *** indicates statistical significance at the 1% level; ** indicates statistical significance at the 5% level; and * indicates statistical significance at the 10% level.

The model regresses a firm-year's relative degree of enterprise risk management (ERM) usage, namely its ERM score ($ERMD_{it}$), on proxies of internal control (IC) in terms of operations ($SALES_{it}$, $\Delta SALES_{it}$), reporting (ICW_N_{it} , $RESTATE_{it}$), and compliance ($AFEE_{it}$, AC_IND_{it} , and AC_EXP_{it}), where:

$SALES_{it}$	=	Net sales deflated by average total assets;
$\Delta SALES_{it}$	=	The percentage change in sales from the previous year;
ICW_N_{it}	=	(−1) times number of IC weaknesses identified;
$RESTATE_{it}$	=	(−1) times restatement dummy variable, which is equal to 1 for restatement of financial report, and 0 otherwise;
$AFEE_{it}$	=	Audit fees deflated by beginning total assets;
AC_IND_{it}	=	The proportion of independent directors;
AC_EXP_{it}	=	Number of financial experts in the audit committee.

Notes

- ¹ These scandals include Waste Management in 1998, Enron in 2001, WorldCom and Tyco in 2002, HealthSouth and Freddie Mac in 2003, American Insurance Group in 2005, Lehman Brothers and Bernie Madoff in 2008, and Saytam in 2009.
- ² According to an American Institute of Certified Public Accountants (AICPA) survey carried out by Beasley et al. (2017), 28% (37%) of the sample firms claimed to have complete (partial) ERM processes in place, whilst among public firms, 49% claimed to have complete ERM processes in place. The survey participants were provided with five choices comprising: (i) no ERM process in place; (ii) currently investigating the concept of ERM, but no decisions yet made; (iii) no formal ERM process in place, but plans in place to implement one; (iv) a partial ERM process in place (i.e., some, but not all, risk areas addressed); and (v) a complete formal ERM process in place.
- ³ COSO refers to the Committee of the Sponsoring Organizations of the Treadway Commission.
- ⁴ The updated ERM Survey carried out in 2014 by Pricewaterhouse Coopers (PWC) confirmed that over 70% of the surveyed firms regarded ERM and IC as being linked; however, while COSO (2017) continues to recognize the overlap between the ERM and IC frameworks, it specifically emphasizes the differences in terms of focus, with neither superseding the other.
- ⁵ Examples include Hoyt and Liebenberg (2011), McShane et al. (2011), Baxter et al. (2013), Farrell and Gallagher (2015), and Chen et al. (2020).
- ⁶ See, for example, Gordon et al. (2009), Hoyt and Liebenberg (2011), and Eckles et al. (2014).
- ⁷ In this case, the validity of the ERM measure may still hold since firms could implement ERM without any corresponding disclosure; however, it is also possible that firms will separately or partially manage certain risk 'silos', which means that they do

not necessarily establish any systematic holistic approach to their risk management policies, whilst the inclusion of the individual effects would ‘contaminate’ the ERM measure.

See Rangan (1998), Teoh et al. (1998), and Francis et al. (2008).

Examples include Healy and Palepu (2001), Dechow and Dichev (2002), and Francis et al. (2005).

See, for example, Becker et al. (1998), Kothari et al. (2005), and Doyle et al. (2007).

See Burgstahler and Dichev (1997), Roychowdhury (2006), and Gunny (2010).

All of the firm-year observations in Compustat over our sample period are generally found to be smaller (mean logarithm of starting total assets = 5.014) and less profitable (mean ROA_{it} = −0.091), with higher future volatility levels (mean SD_OCFit = 0.105), as compared to those with consecutive observations between 2004 and 2014 (mean size = 6.181, mean profitability = −0.087 and mean future volatility = 0.093). However, the differences between these two groups for each measure are not as significant as those between firms with consecutive observations and observations used in the final dataset (mean size = 8.494, mean profitability = 0.152, and mean future volatility = 0.051). The results, therefore, suggest that the requirement is not so critical, as compared to other issues, such as data availability in the various databases or filings.

Financial firms were excluded from the sample for several reasons. Firstly, as a result of industry peculiarities, the constructed measures of financial reporting quality may not be appropriate for financial firms. Secondly, since ERM adoption is more mandatory for financial firms, the effects of implementing ERM in such firms may differ from those in other industries. For example, the National Association of Insurance Commissioners (NAIC) adopted the Risk Management and Own Risk and Solvency Assessment (ORSA) Model Act on 12 September 2012, requiring insurance companies to issue their own assessment of their current and future risk; this Act came into effect on 1 January 2015.

The reasons for the selection of these specific conditions were discussed in detail earlier in Section 3.1, Measurement of ERM.

For example, based upon a 1998–2005 insurance industry sample, Hoyt and Liebenberg (2011) identified an increase in ERM adopters, from less than 5% in 1998 to more than 20% in 2005. In our cross-industry sample, the ERM adoption rate is found to have increased from 23.18% in 2004 to 41.61% in 2014.

Baxter et al. (2013) could find no association between ERM quality and past volatility in daily stock returns in the banking and insurance industries, and although our sample covers only non-financial firms, when compared to the results reported in the extant literature, our results provide further indications of the long-term benefits of ERM.

Our univariate analysis and non-tabulated tests for differences in the means show that for all of the tested variables, the differences between ERM adopters and non-adopters are not significant at the 10% level, which implies that the firm-year observations are comparable across the two groups.

For space-saving considerations, we do not report the tests with the other dependent variables; however, most of the unreported results are found to be consistent with our earlier findings. We also use the ERM implementation indicator, ERM_{it} , to carry out other tests based on the matched sample, with the non-tabulated results again providing support for our main findings.

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